Evapotranspiration, Transpiration and Evaporation from Soil Surface in a Maize Field

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1. Introduction

Daily evapotranspiration (*ET*, mm/day) and mean latent heat fluxes for 30 min. of maize crop were calculated for 50 days of July 29 to Sept. 16, 2004. Both calculated values were determined by using three methods of the energy balance flux ratio method, the energy balance Bowen ratio method and the Penman-Monteith method. Transpiration (*T*, mm/day) of maize was obtained from the sap flow measurement during Aug. 7-16. Evaporation (*E*, mm/day) from soil surface was measured with the microlysimeter during Aug. 9-16 (Odani *et al.*, 2005).

In this manuscript, first, the relationship between *ET* and *E+T* is shown. Second, it is examined that how much in evaporation from soil surface is the quantity of latent heat transferred laterally due to advection in the space of furrow under maize canopy.

2. Measurements

2.1 Observation site

The observation was conducted at the research field of the Cukurova university in Adana. Maize was planted on June 28, 2004. Crop heights changed from 1.43m on July 29 to 3.25m on Sept. 4, and were almost constant after that.

2.2 Measurements of wind speed, temperature and humidity in a furrow under maize canopy

Horizontal wind speed was measured with a hot-wire anemometer at the center of a furrow under maize canopy and the height of 0.3m over soil surface during Aug. 8-15. During the same period, the dry and wet bulb temperatures were measured by the self-made psychrometers with platinum resistance thermometers at two locations of the furrow and the same height as the hot-wire anemometer. The horizontal distance between two psychrometers was 14m. The anemometer was located in the middle of two psychrometers. The width of the furrow was 0.7m.

3. Calculation of latent and sensible heat trans-ferred laterally due to advection

The area of vertical cross section through which advection passed was supposed to be $0.6\times0.7m^2$. The quantities of latent or sensible heat transferred laterally due to advection in evaporation or sensible heat from soil surface were calculated from the difference of latent or sensible heat carried horizontally through the vertical cross section at two locations. The averaging time was 30 minutes. These values were divided by $0.7\times14m^2$, and corrected to values per unite area of soil surface. The quantities of latent and sensible heat transferred due to advection are represented in notations of F_{EA} and F_{HA} in W/m^2, respectively. The daily value in mm/day of F_{EA} is represented with E_A.

4. Results

4.1 Relationship between *ET* and *E+T*

Fig.1 shows the relationship between *ET* and *E+T*. As seen from **Fig.1**, values of *E+T* were larger than values of *ET* by 12%.

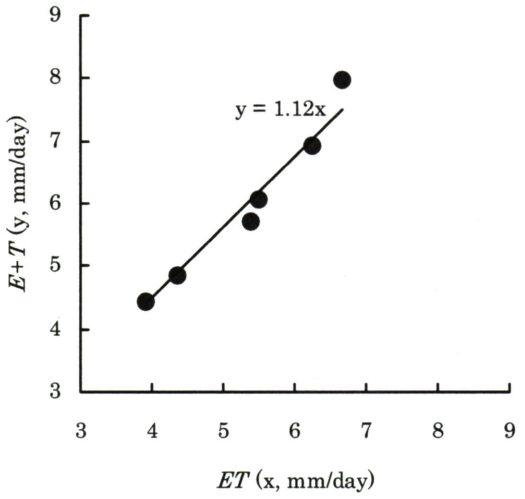

Fig.1 Relationship between *ET* and *E+T*.

From the result of **Fig.1**, the next hypotheses will be made : ① Values of *E+T* were overestimated, ② Values of *ET* were underestimated, and ③Part of evaporation from soil surface was transferred laterally due to advection in the space of furrow under maize

canopy. Here, the hypothesis of ③ was examined.

4.2 Results of wind speed measured under maize canopy

Fig.2 shows the result of horizontal mean wind speed for 30 minutes measured under maize canopy on Aug. 10, 2004. The horizontal wind speeds of about 0.2m/s were measured during the daytime, and there will be possibility that part of evaporation from soil surface is transferred laterally due to advection in the space of furrow under maize canopy. Similar results were obtained on other measurement days.

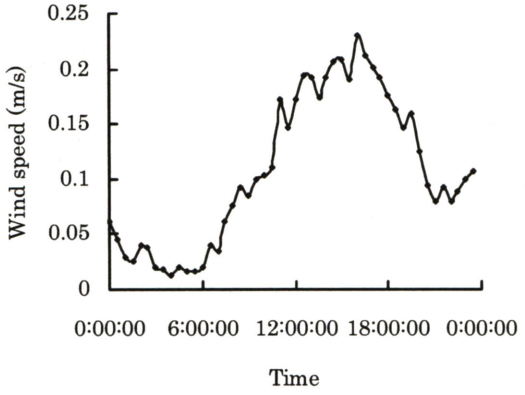

Fig.2 The result of wind speed measured under maize canopy on Aug. 10, 2004.

4.3 Results of F_{EA}, F_{HA} and G (soil heat flux)

Fig.3 shows fluctuations with time of F_{EA}, F_{HA} and G measured on Aug. 10, 2004. F_{HA} was negligibly small. F_{EA} was as large as G during the daytime, and was negligibly small during the nighttime. Similar results were obtained on other measurement days.

4.4 Relationship between $ET+E_A$ and $E+T$

Fig.4 shows the relationship between $ET+E_A$ and $E+T$. As seen from **Fig.4**, values of $E+T$ were larger than values of $ET+E_A$ by 7%.

5. Conclusion

The quantity of water vapor transferred laterally due to advection in the space of furrow under maize canopy was estimated. The sum of this quantity (E_A) and evapotranspiration (ET) and the sum of evaporation (E) from soil surface and transpiration (T) were compared. $ET+E_A$ was smaller than $E+T$ by 7%.

The causes of the underestimation of $ET+E_A$ or the overestimation of $E+T$ ough to be examined after this.

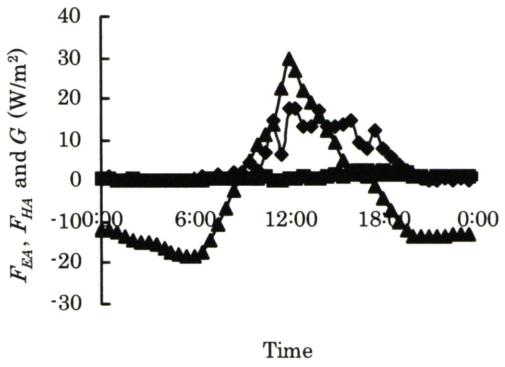

Fig.3 Fluctuations with time of F_{EA} (□), F_{HA}(■) and G (▲) measured on Aug. 10, 2004.

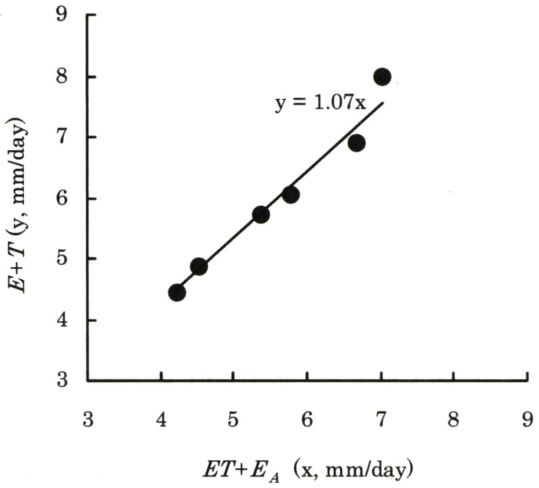

Fig.4 Relationship between $ET+E_A$ and $E+T$.

6. Reference

Odani, H., S. Takeuchi, M. Unlu, K. Sasaki, and T. Tano, 2005:Evapotranspiration of Maize Crop in Adana Region, Turkey, Proceedings of the International Workshop for the Research Project on the Impact of Climate Change on Agricultural Production System in Arid Areas, *Research Institute for Humanity and Nature*, 50-53.